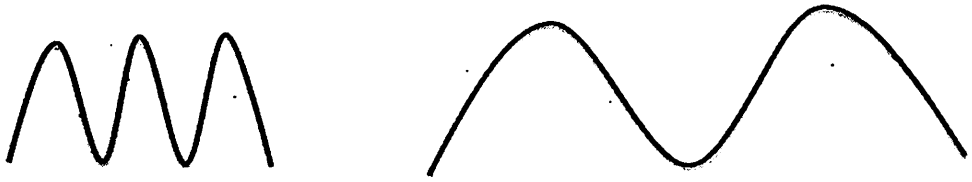
Name_____

AE Chemistry

Wave/Energy Questions

Use the two waves below to answer the following questions.



A B

1. Which of the two waves has the longer wavelength? _____

2. Which of the two waves has the higher frequency? _____

3. If the waves A and B are electromagnetic radiation (light), which wave will travel faster?

Complete the sentences below using your notes:

4. If the wavelength of a wave increases the frequency will _____.

5. If the frequency of a wave increases the wavelength will _____ .

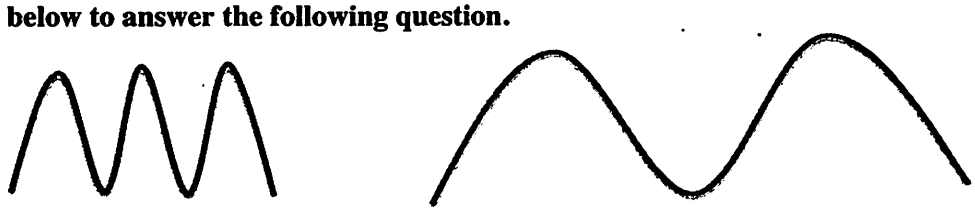
6. A(n) _____ proportion exists between wavelength and frequency of a wave.

7. Electromagnetic radiation transmits _____.

8. Max Planck said that "Energy behaves like_____, because it comes in packets called _____."

9. Einstein called packets of light _____.

Use the two waves below to answer the following question.



A B

10. How did Max Planck relate the energy of a wave to its frequency?

11. Of the two waves above which will have a higher energy? _____

ELECTRON CONFIGURATION (LEVEL ONE)

Name _____

Electrons are distributed in the electron cloud into principal energy levels (1, 2, 3, ...), sublevels (s, p, d, f), orbitals (s has 1, p has 3, d has 5, f has 7) and spin (two electrons allowed per orbital).

Example: Draw the electron configuration of sodium (atomic #11).

Answer: $1s^2$ $2s^2$ $2p^6$ $3s^1$

Draw the electron configurations of the following atoms.

1. Cl

2. N

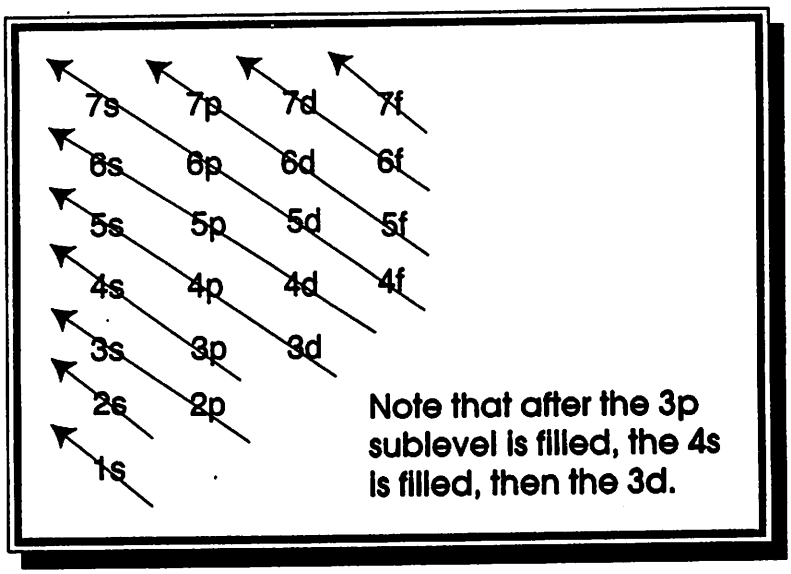
3. Al

4. O

ELECTRON CONFIGURATION (LEVEL TWO)

Name _____

At atomic number greater than 18, the sublevels begin to fill out of order. A good approximation of the order of filling can be determined using the diagonal rule.



Draw the electron configurations of the following atoms.

1. K

2. V

3. Co

4. Zr

VALENCE ELECTRONS

Name _____

Valence electrons are the electrons in the outermost principal energy level. They are always "s" or "s and p" electrons. Since the total number of electrons possible in s and p sublevels is eight, there can be no more than eight valence electrons.

Determine the number of valence electrons in the atoms below.

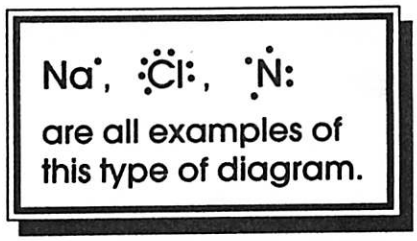
Example: carbon
Electron configuration is $1s^2$ $\boxed{2s^2\ 2p^2}$.
Carbon has 4 valence electrons.

1. fluorine _____
2. phosphorus _____
3. calcium _____
4. nitrogen _____
5. iron _____
6. argon _____
7. potassium _____
8. helium _____
9. magnesium _____
10. sulfur _____
11. lithium _____
12. zinc _____
13. carbon _____
14. iodine _____
15. oxygen _____
16. barium _____
17. aluminum _____
18. hydrogen _____
19. xenon _____
20. copper _____

LEWIS DOT DIAGRAMS

Name _____

Lewis diagrams are a way to indicate the number of valence electrons around an atom



Draw Lewis dot diagrams of the following atoms.

1. calcium
2. potassium
3. argon
4. aluminum
5. bromine
6. carbon
7. helium
8. oxygen
9. phosphorus
10. hydrogen

Name _____ Date _____ Class _____

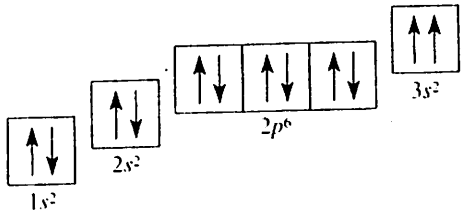
Write the electron configuration, orbital notation, & electron dot

Aluminum

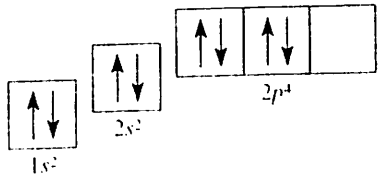
Argon

Boron

Which guideline, Hund's rule or the Pauli exclusion principle, is violated in the following orbital diagrams?



a. _____



b. _____

_____ The wavelength of light is 310 nm. Calculate its frequency. ↑ E

_____ What is the wavelength of electromagnetic radiation if its frequency is 3.2×10^{-2} Hz? ↑ E.

4–1 Review and Reinforcement

Radiant Energy

Complete the following sentences in the space provided.

1. The speed of light is _____ meters per second.
2. All waves can be described in terms of their amplitude, wavelength, and _____.
3. A beam of blue light has a wavelength of 595 nm. Its frequency is _____ s^{-1}.
4. Early in this century, scientists found that light has the characteristics of both waves and _____.
5. The _____ of a wave is the number of complete waves passing a fixed point in a given time.
6. The color of visible light that has the longest wavelength is _____.
7. A wave with a high frequency has a _____ wavelength.
8. The brightness of light depends on the _____ of the light wave.

If the statement is true, write "true." If it is false, change the underlined word or words to make the statement true.

_____ 1. Planck proposed that the energy emitted or absorbed by any object is restricted to quanta of particular sizes.

_____ 2. We are not aware of quantum effects in the world around us because quanta of energy are very large.

_____ 3. In sodium metal, violet light causes the photoelectric effect but red light does not because photons of violet light have less energy than those of red light.

_____ 4. Einstein proposed that light consists of photons, which are quanta of energy that behave like tiny particles.

_____ 5. In the photoelectric effect, protons are ejected from the surface of a metal when light shines on it.

_____ 6. The Planck effect shows that light in the form of a photon can collide with an electron.

_____ 7. We are constantly surrounded by low frequency X-rays.

_____ 8. Planck's theory relates the frequency of radiation to its energy.

_____ 9. The wavelengths of radiation emitted by a hot object shift as its temperature is increased.

_____ 10. The dual nature of light means that light has the properties of a charge and a wave.

4–4 Review and Reinforcement

A New Approach to the Atom

On the line at the left, write the letter of the answer that best completes each statement.

_____ The electron cloud is least dense where the probability of finding an electron is
- **a.** greatest.
- **b.** lowest.
- **c.** highly likely.
- **d.** nonexistent.

_____ The first principal energy level of the hydrogen atom contains only a(n)
- **a.** *s* orbital.
- **b.** *p* orbital.
- **c.** *d* orbital.
- **d.** *f* orbital.

_____ All *p* orbitals are shaped like
- **a.** spheres.
- **b.** doughnuts.
- **c.** dumbbells.
- **d.** footballs.

_____ The 3*s* orbital differs from the 2*s* orbital in that it is
- **a.** smaller.
- **b.** larger.
- **c.** a different shape.
- **d.** more crowded.

_____ The number of sublevels in each principal energy level equals the
- **a.** mass of the atom.
- **b.** electron density of the atom.
- **c.** quantum number for that energy level.
- **d.** number of electrons in the atom.

_____ Which sublevels can be found in the fourth principal energy level of an atom?
- **a.** *s* and *p*
- **b.** *s*, *p*, and *d*
- **c.** *s*, *p*, *d*, and f
- **d.** *s*, *p*, *d*, *f*, and *g*

Answer each of the following questions in the space provided.

How does the quantum-mechanical model of the atom describe electrons?

1. Heisenberg's uncertainty principle states that the position and the _____ of a moving object cannot simultaneously be measured and known exactly.

2. _____ used Planck's idea of quantization to explain the line spectrum of hydrogen.

3. Bohr labeled each _____ in his atomic model by a quantum number.

4. An electron that absorbs a quantum of energy can jump to a level of _____ energy, called an excited state of the atom.

5. _____ is emitted when an electron jumps from a higher energy level to a lower energy level.

Circle the letter of the answer that best completes each statement.

6. The Bohr model is an inaccurate model of the atom because there is no way to measure the exact _____ of an electron in an atom.
   - **a.** charge
   - **b.** path
   - **c.** mass
   - **d.** all of the above

7. When radiation is absorbed by a hydrogen electron, the hydrogen atom changes its ground state to _____ .
   - **a.** an excited state
   - **b.** another atom
   - **c.** a lower state
   - **d.** the nucleus of the atom

Answer each of the following questions in the space provided.

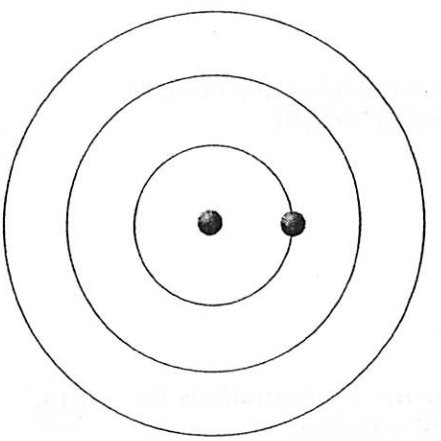
8. Describe the difference between a continuous spectrum and a line spectrum, and name a source of each kind of spectrum.

_____

_____

_____

Use the diagram below to answer each of the following questions.



9. Label the energy levels $n = 1$, $n = 2$, and $n = 3$ on the Bohr atom.

10. Label the ground state in this atom.

11. Label an excited state in this atom.

12. Draw an arrow to show the direction an electron moves when it absorbs energy.

4

Complete the chart below by filling in the correct number of orbitals and electrons in each sublevel.

Sublevel	Number of orbitals	Maximum number of electrons
s		
p		
d		
f		

1. Write out the electron configurations for (a) potassium and (b) cobalt. How many unpaired electrons does each possess?

2. Which element has the following electron configuration: $1s^2 2s^2 2p^3$?

3. Write out the electron configurations for (a) silicon and (b) lithium. How many unpaired electrons does each possess?

4. Which element has the following electron configuration: $1s^2 2s^2 2p^6 3s^2 3p^3$?

5. Write out the electron configurations for (a) iridium and (b) selenium. How many unpaired electrons does each possess?

6. Which element has the following electron configuration: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$?

7. Write out the electron configurations for (a) bismuth and (b) vanadium. How many unpaired electrons does each possess?

8. Which element has the following electron configuration: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10}$?

9. Write out the electron configurations for (a) sulfur and (b) mercury. How many unpaired electrons does each possess?

10. Which element has the following electron configuration: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^6$?

6, 7, 8, + 10 have e⁻ Configs then incorrectly. Don't make the same mistake

Electron Configurations

If the statement is true, write "true." If it is false, change the underlined word or words to make the statement true.

1. The Pauli exclusion principle states that an orbital can hold a maximum of <u>two</u> electrons.
2. The sum of the superscripts in an electron configuration represents the total number of <u>neutrons</u> in the atom.
3. The Aufbau principle states that electrons are added one at a time to the <u>highest</u> energy orbitals available until all the electrons of the atom have been accounted for.
4. An <u>orbital diagram</u> uses arrows to represent the spin of the electrons.
5. The ground state is the <u>least</u> stable energy state of an atom.
6. According to Hund's rule, electrons occupy equal energy orbitals so that a maximum number of <u>unpaired</u> electrons results.

Write the orbital Config for each of the following elements.

7. magnesium

8. oxygen

9. aluminum

10. argon

11. scandium

12. phosphorus

Identify the elements that have the following electron configurations. Write the chemical symbol for each element in the space provided.

13. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
14. $1s^2 2s^2 2p^6 3s^2 3p^2$
15. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$
16. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

Don't make this mistake.

17. $1s^2 2s^2 2p^6$

Electron Configurations

If the statement is true, write "true." If it is false, change the underlined word or words to make the statement true.

T
1. The Pauli exclusion principle states that an orbital can hold a maximum of <u>two</u> electrons.

F e^-
2. The sum of the superscripts in an electron configuration represents the total number of <u>neutrons</u> in the atom.

F lowest
3. The Aufbau principle states that electrons are added one at a time to the <u>highest</u> energy orbitals available until all the electrons of the atom have been accounted for.

F orbital notation
4. An <u>orbital diagram</u> uses arrows to represent the spin of the electrons.

F most
5. The ground state is the <u>least</u> stable energy state of an atom.

F paired
6. According to Hund's rule, electrons occupy equal energy orbitals so that a maximum number of <u>unpaired</u> electrons results.

Write the orbital Con Hy for each of the following elements.

7. magnesium — $\underset{1s}{\uparrow\downarrow}\ \underset{2s}{\uparrow\downarrow}\ \underset{2p}{\uparrow\downarrow\uparrow\downarrow\uparrow}\ \underset{3s}{\uparrow\downarrow}$

8. oxygen — $\underset{1s}{\uparrow\downarrow}\ \underset{2s}{\uparrow\downarrow}\ \underset{2p}{\uparrow\downarrow\uparrow\ \uparrow}$

9. aluminum — $\underset{1s}{\uparrow\downarrow}\ \underset{2s}{\uparrow\downarrow}\ \underset{2p}{\uparrow\downarrow\uparrow\downarrow}\ \underset{3s}{\uparrow\downarrow}\ \underset{3p}{\uparrow\ \_\ \_}$

10. argon — $\underset{1s}{\uparrow\downarrow}\ \underset{2s}{\uparrow\downarrow}\ \underset{2p}{\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow}\ \underset{3s}{\uparrow\downarrow}\ \underset{3p}{\uparrow\downarrow\uparrow\downarrow}$

11. scandium — $\underset{1s}{\uparrow\downarrow}\ \underset{2s}{\uparrow\downarrow}\ \underset{2p}{\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow}\ \underset{3s}{\uparrow\downarrow}\ \underset{3p}{\uparrow\downarrow\uparrow\downarrow\uparrow\downarrow}\ \underset{3d}{\uparrow\ \_\ \_\ \_\ \_}\ \underset{4s}{\uparrow\downarrow}$

12. phosphorus — $\underset{1s}{\uparrow\downarrow}\ \underset{2s}{\uparrow\downarrow}\ \underset{2p}{\uparrow\downarrow\uparrow\downarrow\uparrow}\ \underset{3s}{\uparrow\downarrow}\ \underset{3p}{\uparrow\ \uparrow\ \uparrow}$

Identify the elements that have the following electron configurations. Write the chemical symbol for each element in the space provided.

Ca
13. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

Si
14. $1s^2 2s^2 2p^6 3s^2 3p^2$

V
15. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

Br
16. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

Don't make this mistake.

Ne
17. $1s^2 2s^2 2p^6$